

a sample container for holding a PCR sample, the sample container comprising an optically clear material, the sample container formed for holding less than 1 milliliter of a sample and having a first side, a second side, and an end;

means for positioning the PCR sample container in a monitoring position;

means for heating the PCR sample;

means for cooling the PCR sample;

control means for repeatedly operating the means for heating and the means for cooling to subject the PCR sample to thermal cycling;

means for optically exciting the sample during at least a portion of the thermal cycling to cause the sample to fluoresce; and

means for detecting the fluorescence of the excited sample during at least a portion of the thermal cycling when the sample is in the monitoring position.

14. (Amended) A system for performing PCR and monitoring the reaction in real time during temperature cycling as defined in claim 13 further comprising:

means for determining at least one reaction parameter in accordance with the detected fluorescence[; and

means for adjusting the control means in accordance with the reaction parameter].

24. (Amended) A system for performing PCR and monitoring the reaction in real time during temperature cycling as defined in claim 13 wherein the means for optically exciting the sample comprises a photo emitter structure positioned so that the radiation emitted therefrom impinges the first side of the sample container.

25. (Twice Amended) A system for performing PCR and monitoring the reaction in real time during temperature cycling as defined in claim 24 wherein means for

detecting the fluorescence of the excited sample comprises a photo detector structure positioned so that the radiation emitted from the second side of the sample container is detected.

28. (Twice Amended) A system for performing PCR and monitoring the reaction in real time during temperature cycling as defined in claim [13] 14 wherein the means for determining at least one reaction parameter in accordance with the detected fluorescence comprises means for determining at least one reaction parameter selected from the group consisting of: product melting temperature, product melting time, product reannealing temperature, product reannealing time, probe melting time, primer annealing/extension temperature, and primer annealing/extension time.

33. (Twice Amended) A system for performing PCR and monitoring the reaction in real time during temperature cycling comprising:

a plurality of sample containers for holding a plurality of PCR samples, each sample container comprising an optically clear capillary tube, each sample container formed for holding less than 1 milliliter of a sample and having a sealed end and an open end with a sealable closure on the open end;

means for holding a plurality of sample containers, the means for holding comprising a rotatable carousel formed for holding the sample containers;

means for forcing hot fluid into contact with the plurality of sample containers;

means for forcing cool fluid into contact with the plurality of sample containers;

means for repeatedly operating the means for forcing hot fluid and the means for forcing cool fluid to subject the PCR samples to thermal cycling;

means for optically exciting at least one selected PCR sample to cause the selected PCR sample to fluoresce;

means for detecting the fluorescence of the excited selected PCR sample at both a first wavelength and a second wavelength; and

means for determining at least one reaction parameter for the selected PCR sample in accordance with the fluorescence at the first and second wavelengths and displaying the reaction parameter in a visually perceptible manner in real time.

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55. (Twice Amended) A system for carrying out and monitoring the progress of first and second biological reactions comprising:

first holding means for holding a first biological sample;

second holding means for holding a second biological sample;

transporting means for moving the first and second holding means [for holding] between a non-monitoring position and [to] a monitoring position;

thermal cycling means for repeatedly heating and cooling the first holding means and the second holding means in both the non-monitoring position and in the monitoring position to carry out thermal cycling on both the first biological sample and the second biological sample;

monitoring means for ascertaining the progress of the first biological reaction in the first means for holding and the second biological reaction in the second means for holding when the first and second biological samples are in the monitoring position, the means for monitoring comprising means for detecting radiation emitted from the first and second biological samples; and

controlling means for controlling the operation of the transporting means, thermal cycling means, and the monitoring means such that the progress of the first and second biological reactions is detected as thermal cycling occurs.

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87. (Amended) A system for performing PCR and monitoring the reaction [in real time] comprising;

a chamber;

a heater and a fan in air flow communication with the chamber and a controller for cycling the temperature in the chamber according to initial predefined temperature and time parameters;

a carousel for holding a plurality of sample vessels said carousel being rotatably mounted in said chamber, said sample vessels comprising an optically transparent material and walls defining a volume having at least first and second dimensions wherein the first dimension is less than the second dimension and wherein the ratio of volume to external surface area of the vessel is less than 1 mm;

a light emitting source mounted in said chamber and positioned to illuminate at least one of the sample vessels during at least a portion of the temperature cycling along an axis substantially parallel to a wall along the second dimension of the vessel;

a light detector mounted in said chamber and positioned to measure fluorescence from at least one of the sample vessels during at least a portion of the temperature cycling along an axis substantially parallel to a wall along the second dimension of the vessel;  
and

means for displaying the status of the reaction based on detected fluorescence.

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120. (Amended) The device of [claims] claim 119 wherein the chamber is further provided with a heater and a fan mounted in said device in air flow communication with the chamber and a controller therefor for rapidly cycling the temperature of the chamber.

D10 SUB  
E15

122. (Amended) A system for performing PCR and monitoring the reaction [in real time] comprising:

a chamber;

a heater and a fan in air flow communication with the chamber and a controller for cycling the temperature in the chamber according to initial predefined temperature and time parameters;

a carousel for holding a plurality of sample vessels said carousel being rotatably mounted in said chamber, said sample vessels comprising an optically transparent material and walls defining a volume having at least first and second dimensions wherein the first dimension is less than the second dimension and wherein the ratio of volume to external surface area of the vessel is less than 1mm;

a light emitting source positioned to illuminate at least one of the sample vessels in the chamber during at least a portion of the temperature cycling along an axis substantially parallel to a wall along the second dimension of the vessel; [and]

a light detector positioned to measure fluorescence from at least one of the sample vessels in the chamber during at least a portion of the temperature cycling along an axis substantially parallel to a wall along the second dimension of the vessel; and

means for displaying the status of the reaction based detected fluorescence.

123. (Amended) The system of claim 122 further comprising means for adjusting the controller such that one or more reaction parameters the reaction is adjusted [in real time] during temperature cycling.

128. (Amended) A system for performing PCR and monitoring the reaction in real time during temperature cycling comprising;

a sample container for holding a PCR sample, the sample container comprising an optically clear material, the sample container formed for holding less than 1 milliliter of a sample and having a first side, a second side, and an end;

means for positioning the PCR sample container in a monitoring position;  
means for heating the PCR sample;  
means for cooling the PCR sample;  
control means for repeatedly operating the means for heating and the means for cooling to subject the PCR sample to thermal cycling;  
means for optically exciting the sample during at least a portion of the thermal cycling to cause the sample to fluoresce;  
means for detecting the fluorescence of the excited sample during at least a portion of the thermal cycling when the sample container is in the monitoring position;  
means for determining at least one reaction parameter in accordance with the detected fluorescence; and  
means for adjusting the control means in accordance with the reaction parameter.

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136. (Amended) A system for performing PCR and monitoring the reaction in real time during temperature cycling as defined in claim 128 wherein the means for optically exciting the sample comprises a photo emitter structure positioned so that the radiation emitted therefrom impinges the second side of the sample container.

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137. (Amended) A system for performing PCR and monitoring the reaction in real time during temperature cycling as defined in claim 136 wherein means for detecting the fluorescence of the excited sample comprises a photo detector structure positioned so that the radiation emitted from the second side of the sample container is detected.

D13 SUB  
F17

145. (Amended) A system for performing PCR and monitoring the reaction in real time during temperature cycling comprising:

a plurality of sample containers for holding a plurality of PCR samples, each sample container comprising an optically clear capillary tube, each sample container formed for holding less than 1 milliliter of a sample and having a sealed end and an open end with a sealable closure on the open end;

means for holding a plurality of sample containers, the means for holding comprising a rotatable carousel formed for holding the sample containers;

means for forcing hot fluid into contact with the plurality of sample containers;

means for forcing cool fluid into contact with the plurality of sample containers;

means for repeatedly operating the means for forcing hot fluid and the means for forcing cool fluid to subject the PCR samples to thermal cycling;

means for optically exciting at least one selected PCR sample to cause the selected PCR sample to fluoresce;

means for detecting the fluorescence of the excited selected PCR sample at both a first wavelength and a second wavelength;

means for determining at least one reaction parameter for the selected PCR sample in accordance with the detected fluorescence at the first and second wavelengths and displaying the reaction parameter in a visually perceptible manner in real time; and

means for adjusting the means for repeatedly operating in accordance with the reaction parameter such that the reaction is adjusted in real time.

152. (Amended) A system for performing PCR and monitoring the reaction [in real time] comprising:

a chamber;

a heater and a fan in air flow communication with the chamber and a controller

for cycling the temperature in the chamber according to initial predefined temperature and time parameters;

a carousel for holding a plurality of sample vessels said carousel being rotatably mounted in said chamber; the carousel comprising a disc having a top surface, a bottom surface, and an outer edge extending therebetween, a sample receiving port in the top surface, a sample vessel port in the outer edge, and a sample passageway communicating with said sample receiving port and the sample vessel port, said sample vessel port and passageway formed for receiving and fixing a sample vessel to the disc; the passageway including a barrier that prevents a liquid sample delivered through the sample receiving port from flowing to the sample vessel port absent a biasing force on said liquid sample;

said sample vessels comprising an optically transparent material and walls defining a volume having at least first and second dimensions wherein the first dimension is less than the second dimension and wherein the ratio of volume to external surface area of the vessel is less than 1 mm;

a light emitting source positioned to illuminate at least one of the sample vessels in the chamber during at least a portion of the temperature cycling along an axis substantially parallel to a wall along the second dimension of the vessel;

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a light detector positioned to measure fluorescence from at least one of the sample vessels in the chamber during at least a portion of the temperature cycling along an axis substantially parallel to a wall along the second dimension of the vessel; and

a display for displaying the status of the reaction based detected fluorescence.